

CORTICO-CEREBELLAR PATHWAYS FOR UNDERSTANDING LANGUAGE COORDINATION



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BACKGROUND

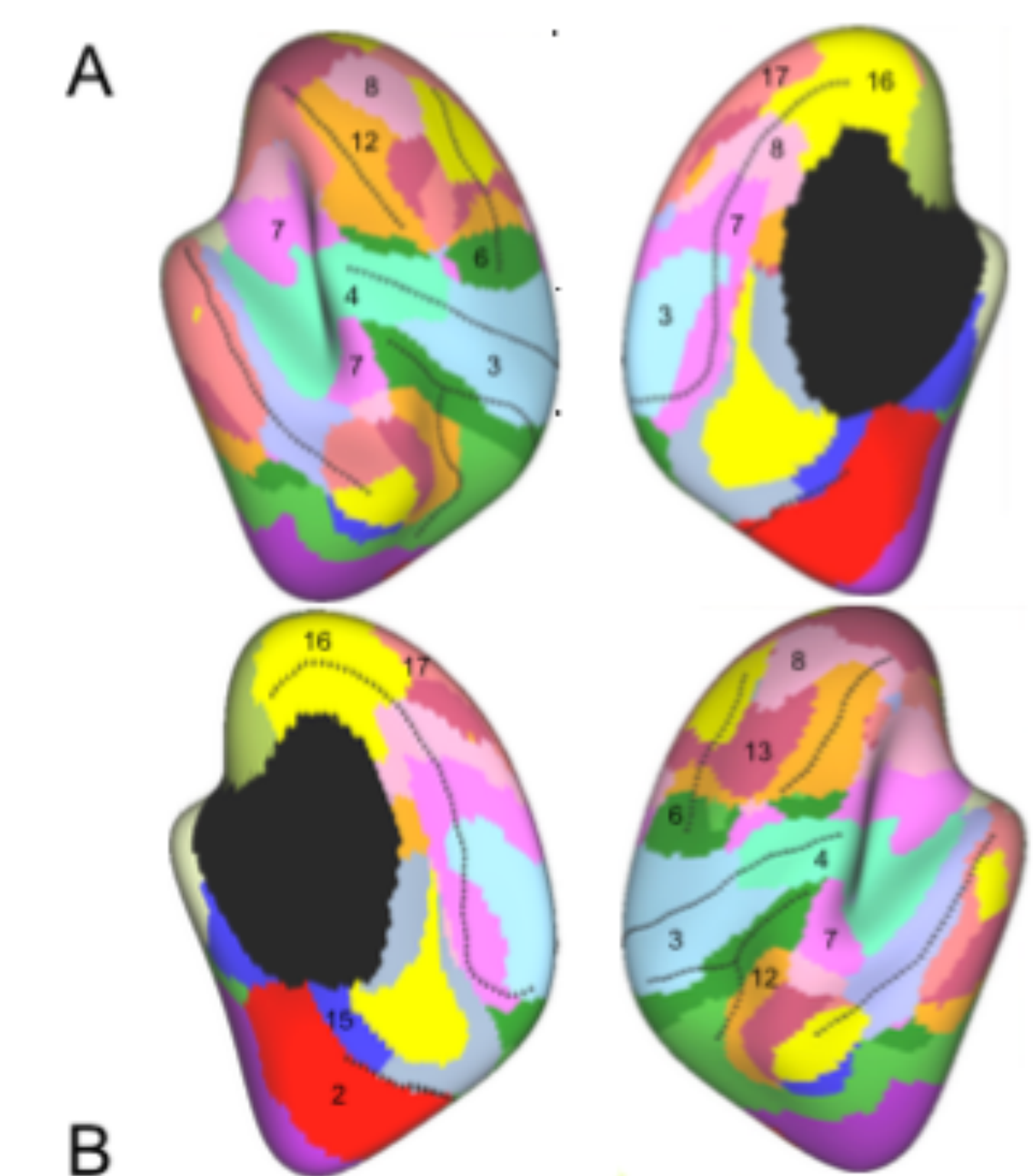
The connective AND evokes a single Gestalt by accumulating and merging information. The connective OR evokes two Gestalts.

The right cerebral hemisphere manages conflicts by assessing, rejecting, or refining explanations when faced with new evidence. The left cerebral hemisphere builds coherence by drawing inferences or creating explanations at the cost of ignoring evidence or clashing explanations.

Cognitive processing activates the posterior lobes of the cerebellum, corresponding to contralateral areas of the cerebrum.

The right cerebellum is more relevant to linguistic processing; the left cerebellum is more concerned with spatial information.

Whole-Brain Searchlight



Resting State Networks

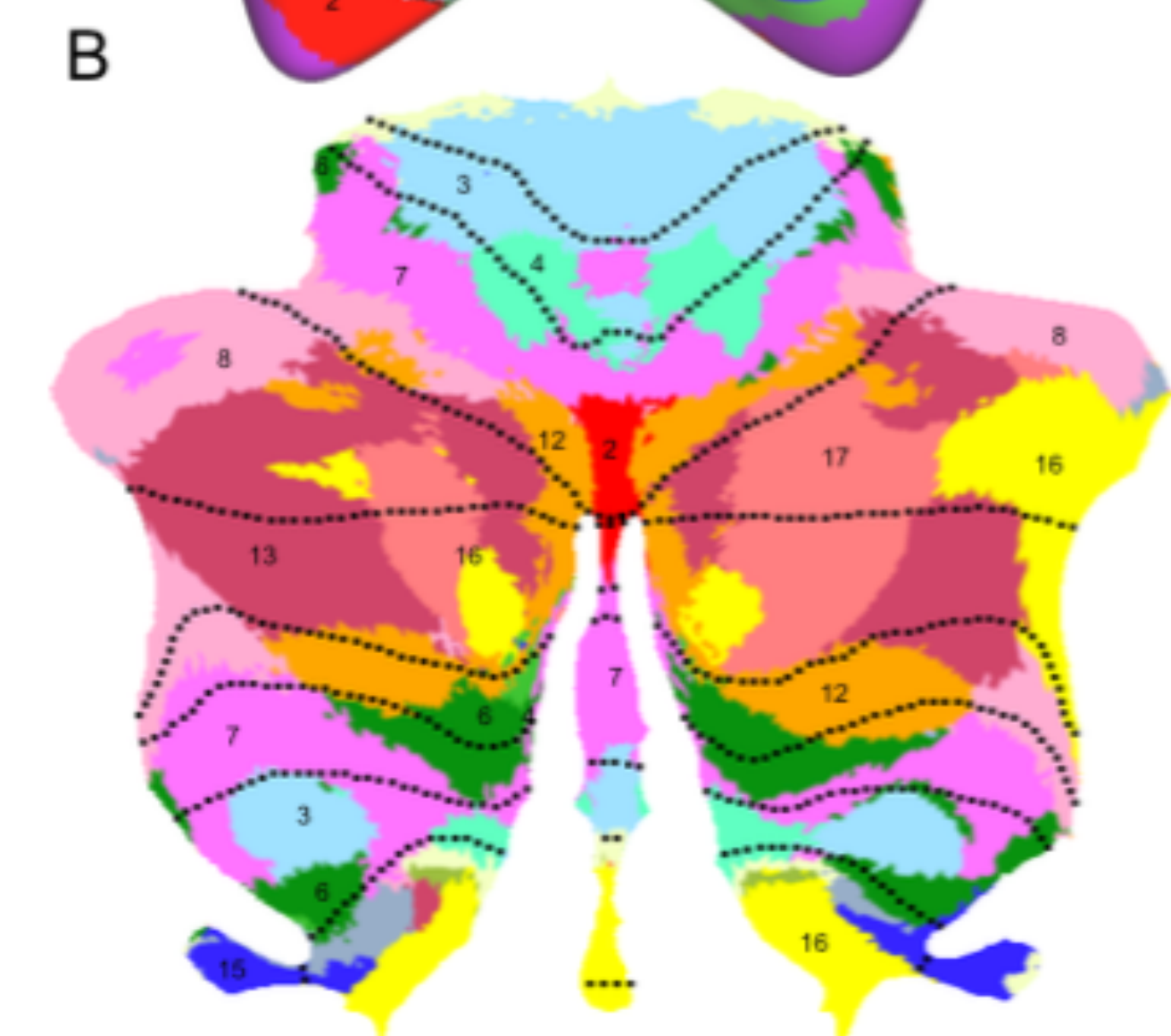
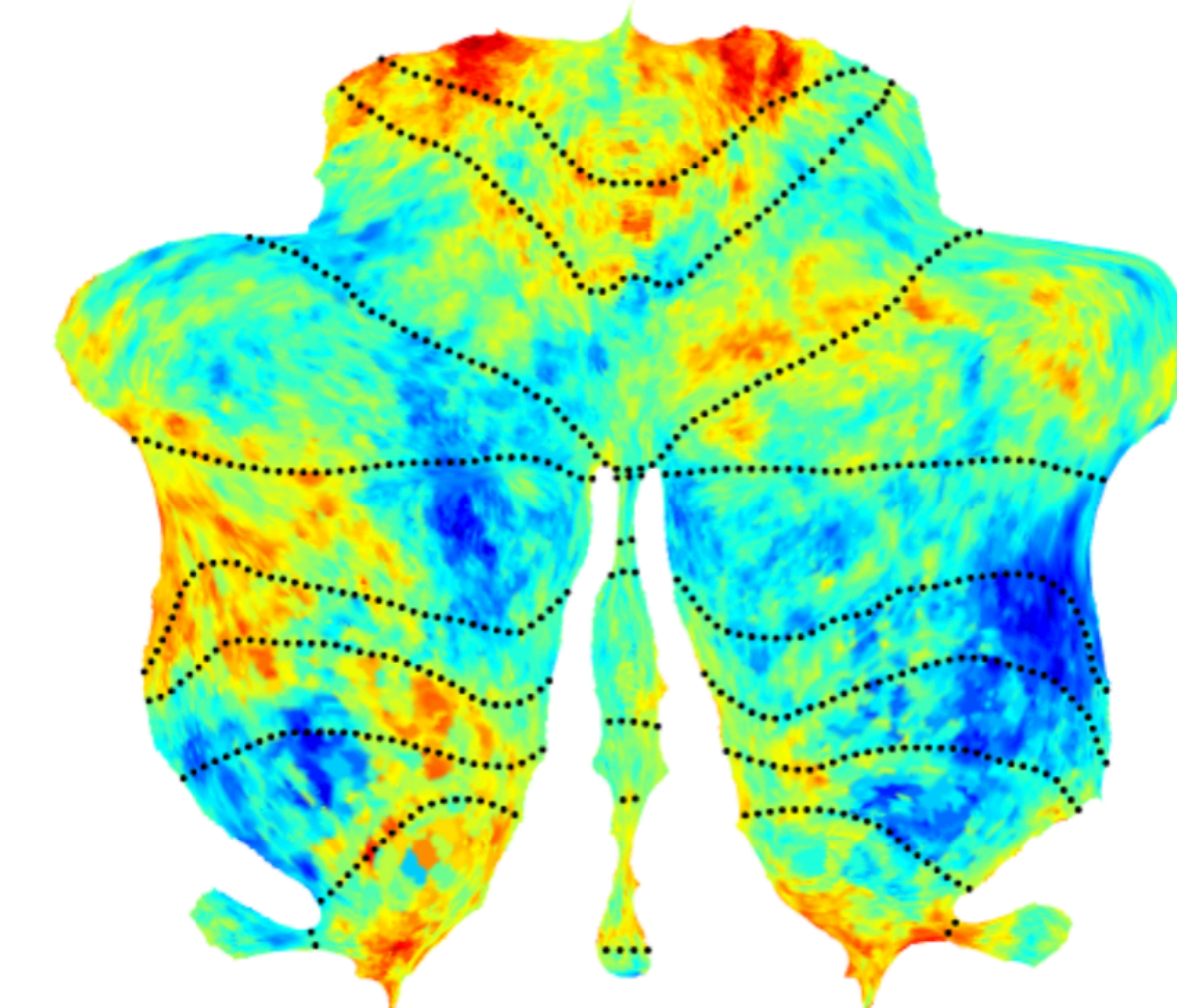
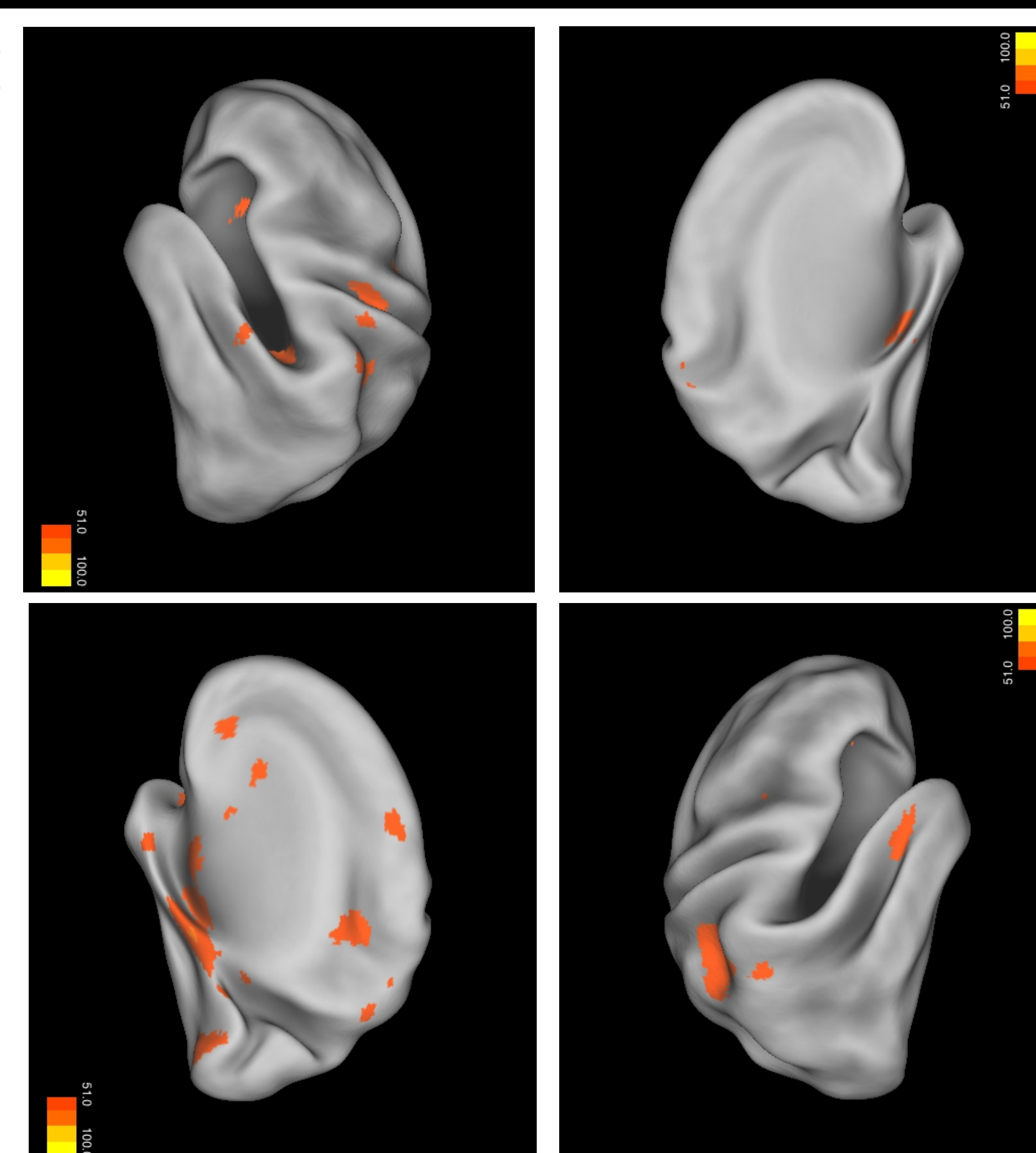
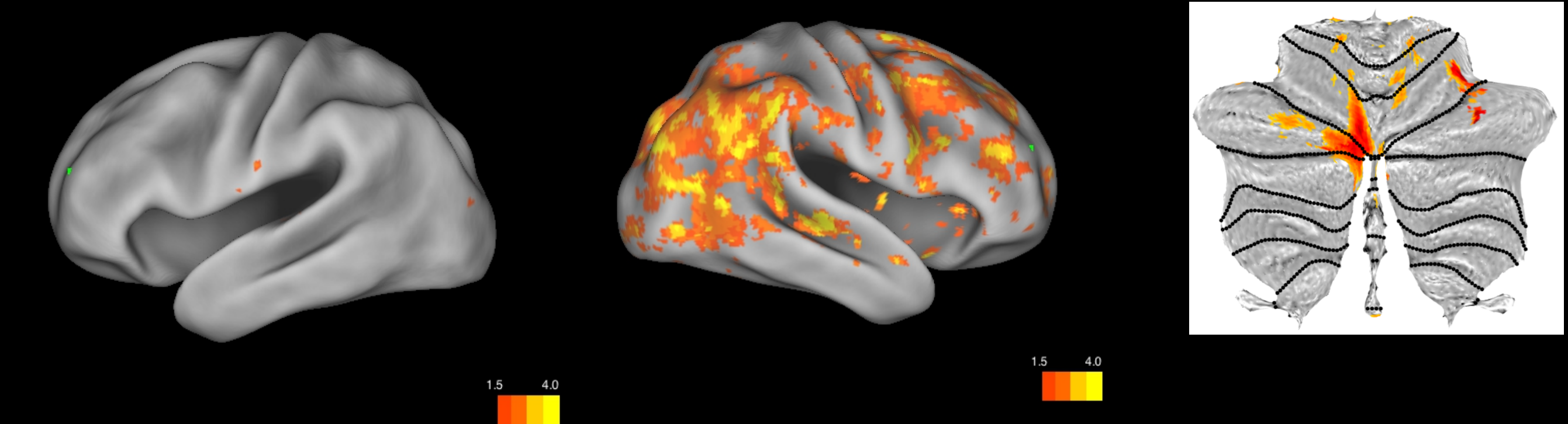


Fig 8. Atlas of cerebellar-cortical connectivity. (A) Cortical networks of resting-state connectivity [23]. 17 networks are shown on an inflated cortical surface of the left and right hemisphere—with both the lateral and medial surface shown. (B) Map showing the cortical resting-state network that correlated best with the activity in the corresponding cerebellar area [18]. Maps are based on N = 1000 subjects. doi:10.1371/journal.pone.0133402.g008

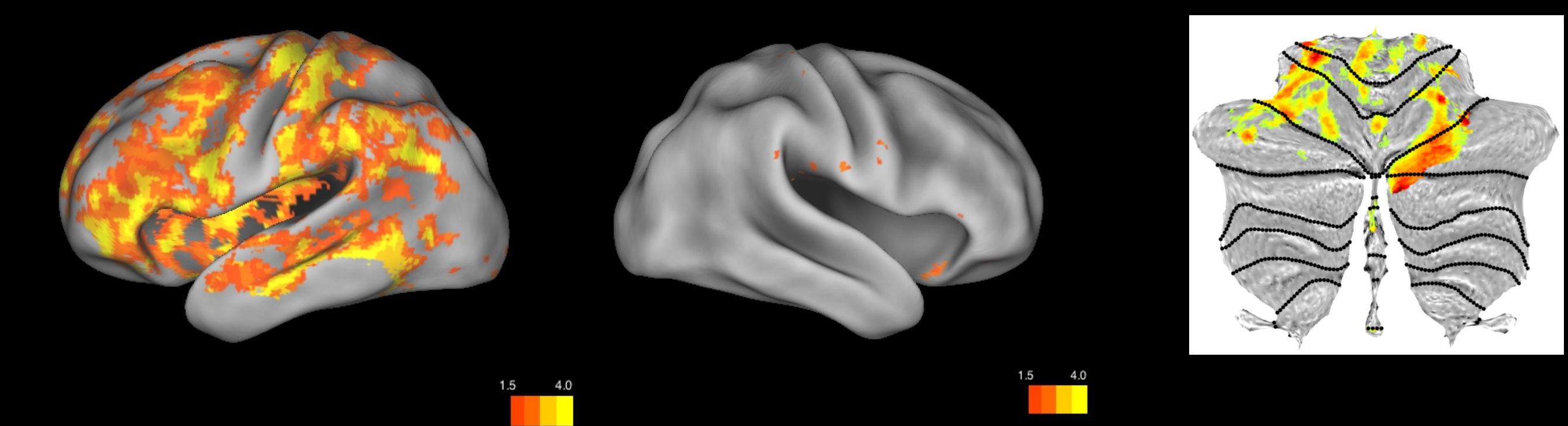


Univariate Analysis

AND > OR L.I. - 0.493



OR > AND L.I. + 0.362



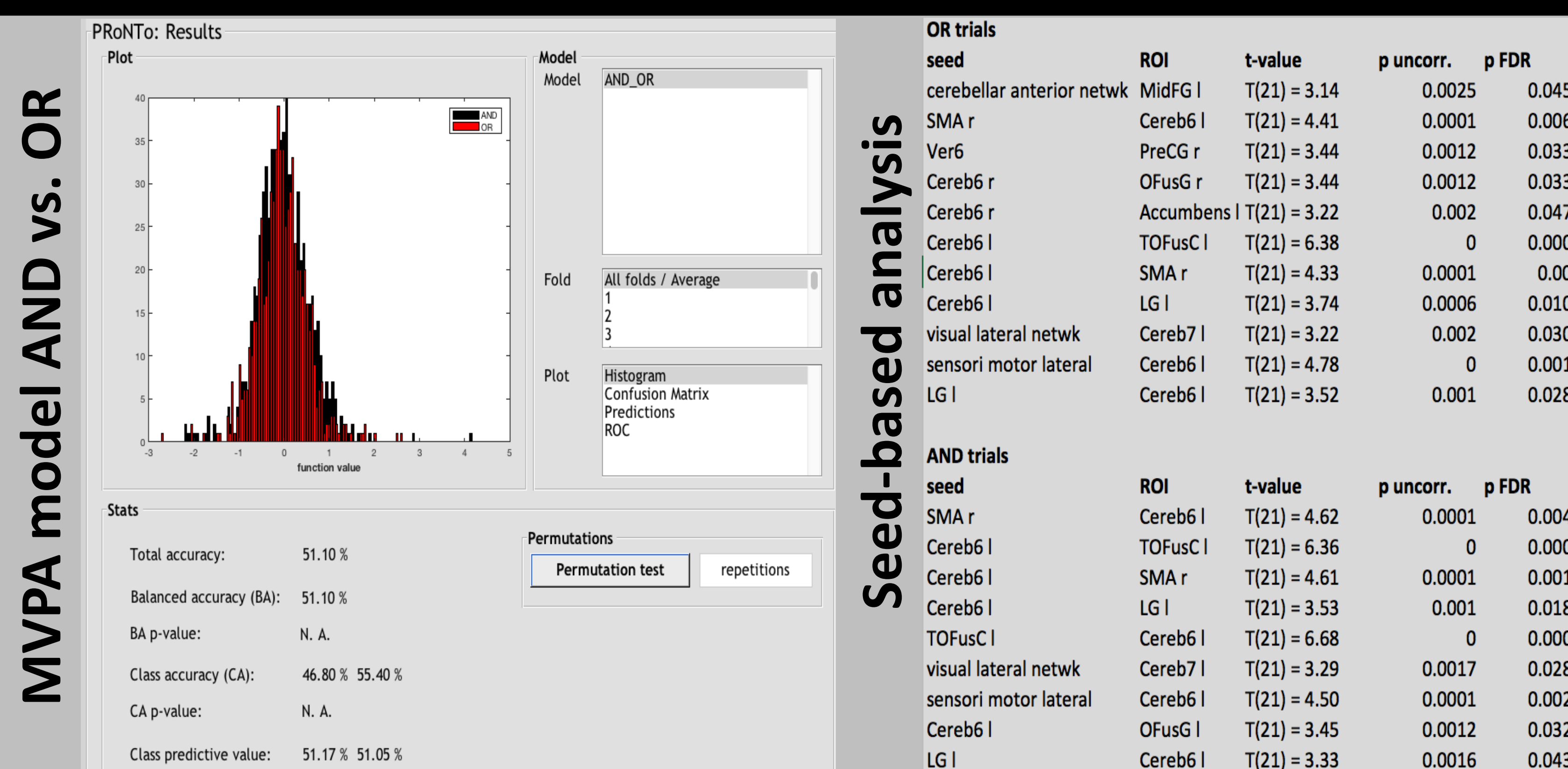
RATIONALE & MATERIALS

We investigated the role of cortico-cerebellar pathways in understanding the discourse connectives **AND** & **OR**.

We predicted complementary cerebral lateralisation and contralateral cerebellar activation.

Volunteers: 22 right-handed adults
Scanner: 3T Siemens Magnetom Prisma

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Buckner, R. L., Krienen, F. M., Castellanos, A., Diaz, J. C., & Yeo, B. T. T. (2011). The organization of the human cerebellum estimated by intrinsic functional connectivity. *J. Neurophysiol* 106, 2322-2345; Diedrichsen, J. (2015). Cerebellar toolbox (SUIT). Available from: <http://www.icn.ucl.ac.uk/motorcontrol/imaging/suit.htm>; Dumitru, M. L., & Joergensen, G. H. (2016). Gestalt reasoning with conjunctions and disjunctions. *PLoS ONE* 11(3): e0151774; Eickhoff et al. (2005). A new SPM Toolbox for combining probabilistic cytoarchitectonic maps and functional imaging data. *Neuroimage* 25, (4): 1325-1335; Penny, W., Friston, K., Ashburner, J., Kiebel, S., & Nichols, T. (2006). *Statistical Parametric Mapping: The Analysis of Functional Brain. 1st Edition*, Academic Press; Stoodley, C. J., & Schmahmann, J.D. (2010). Functional topography in the human cerebellum: a meta-analysis of neuroimaging studies. *Neuroimage*, 44, 489-501; Schrouff, J., Rosa, M. J., Rondina, J. M., Marquand, M. F., Chu, C., Ashburner, J., et al. (2013). PRoNT: Pattern Recognition for Neuroimaging Toolbox. *Neuroinformatics*, 11, 319-337 - https://github.com/CyclotronResearchCentre/PRoNT_SearchLight; Turner, B. O., Marinsek, N., Ryhal, E., & Miller, M. B. (2012). Hemispheric lateralisation in reasoning. *Ann. N.Y. Acad. Sci.* 1259, 47-64

CONCLUSIONS

AND activates the right cerebral and the left cerebellar hemispheres.

OR activates the left cerebral and the right cerebellar hemispheres.

Neural patterns revealed by whole-brain searchlight analysis suggest rapid recruitment of spatial reasoning cortical areas upon hearing the two connectives.